Drought Predictability on Intraseasonal to Seasonal and Longer Time Scales

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Pathways to Predictability

SST anomalies → Global-Scale Atmospheric Changes → Regional Forcing and land feedbacks → Local Impacts, user needs

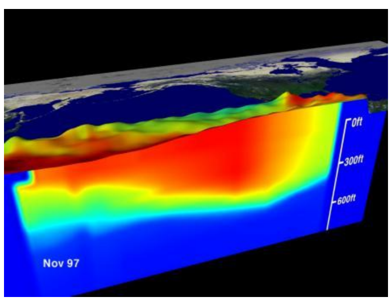
Key Phenomena, variables

ENSO, PDO, AMO, warm pool variability, Global Warming, etc

planetary waves, hydrological cycle, monsoons, Hadley Cell, Walker Circulation

precipitation, soil moisture, snow, low level jets, dust, vegetation, land/atmosphere contrasts, changes in weather

soil moisture, stream flow, precipitation, ground water, lakes, reservoirs



Modeling Issues

Improvements in global coupled models, estimates of ocean variability and predictability, GHGs

Reduce uncertainties in atmos. response to SST, water cycle, atmos. variability and predictability

Reduce uncertainties in modeling land/atmosphere interactions, predictability of weather “regimes”, regional climate phenomena

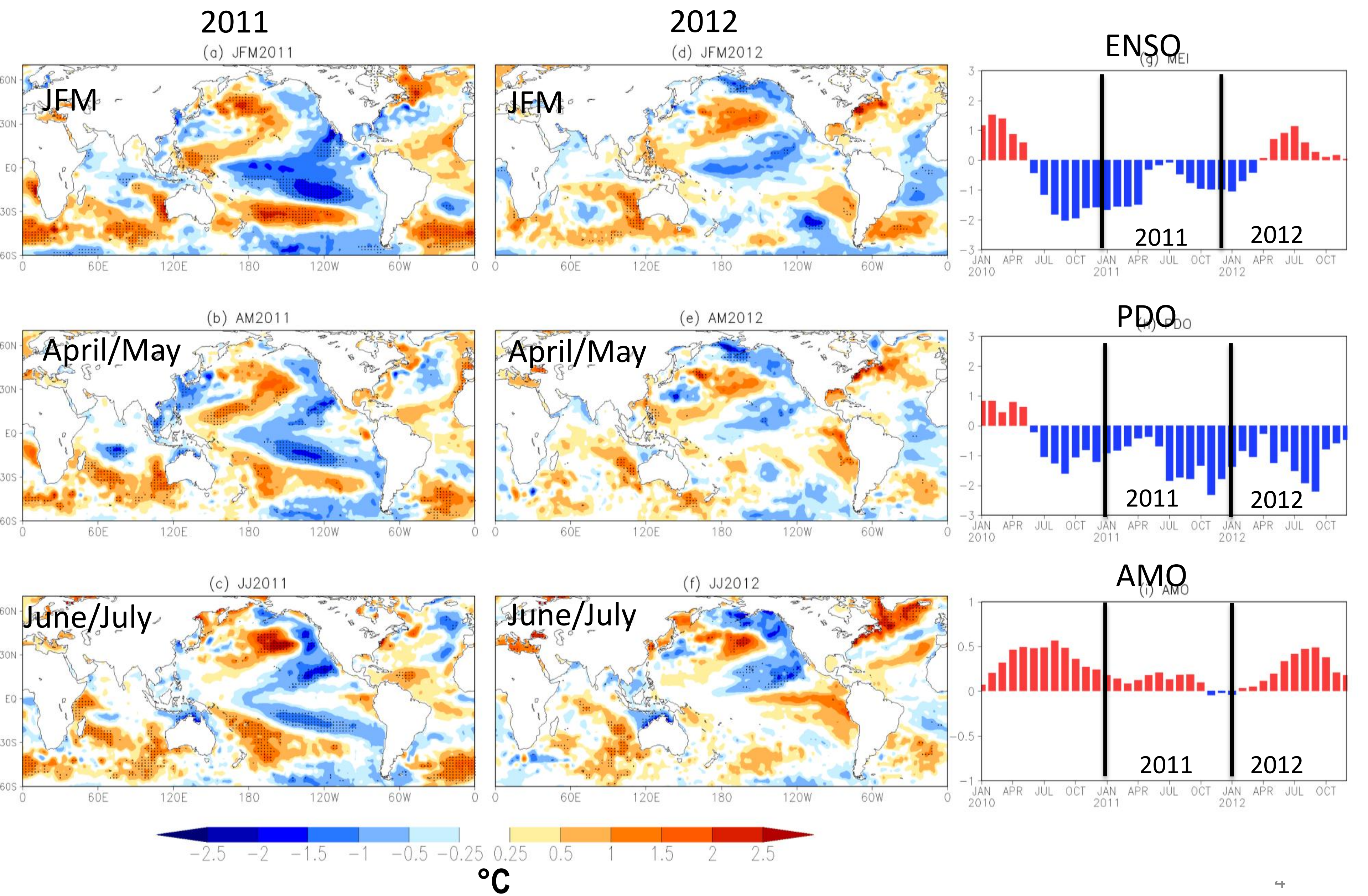
Improved modeling of “downstream” impacts on land hydrology, higher resolution, downscaling

Case Study of Role of SST
(2011 versus 2012 US Drought/Heat)

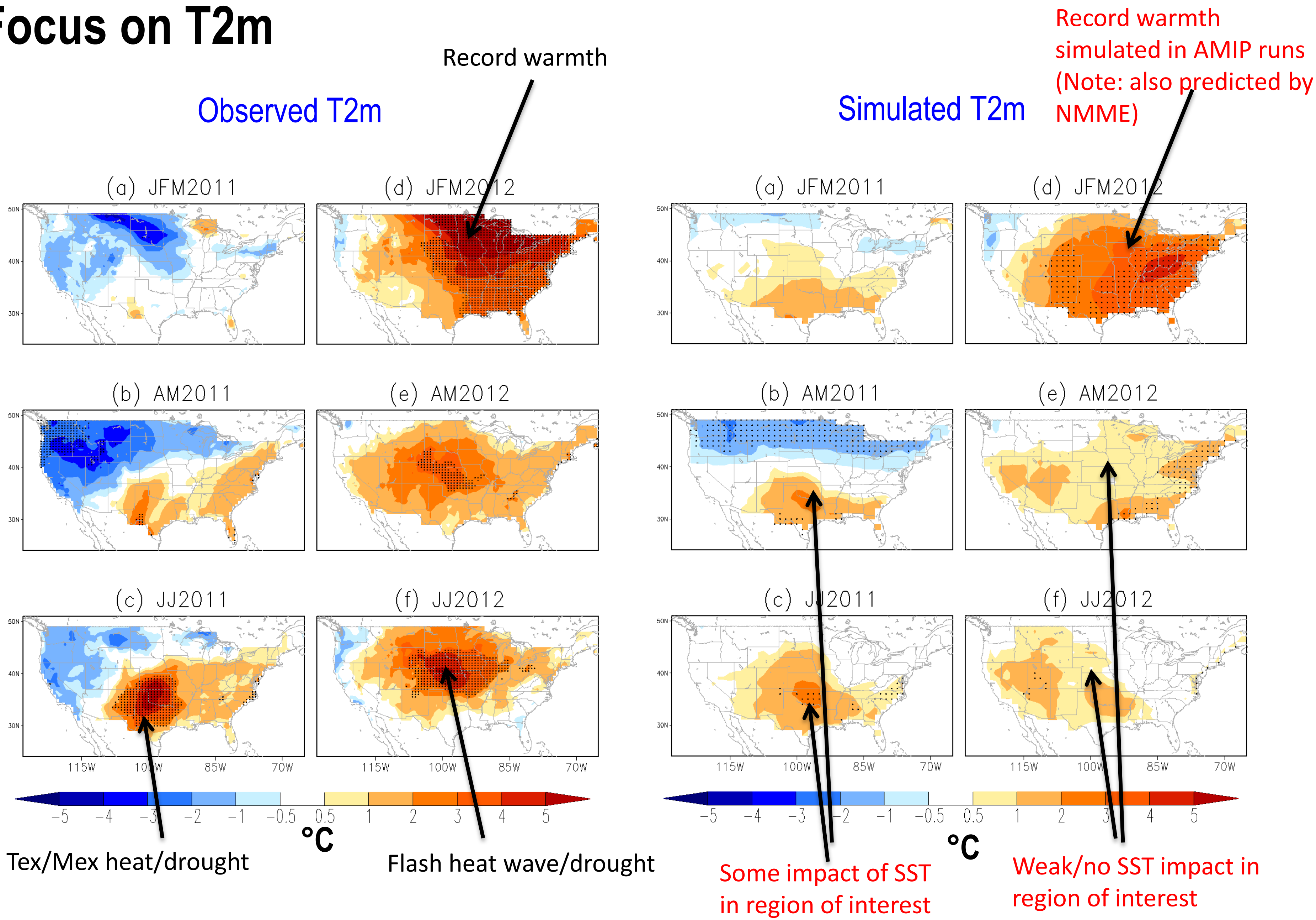
DTF JHM special collection:

On the role of SST forcing in 2011 and 2012 Extreme U.S. Heat and Drought: A Study in Contrasts, Hailan Wang, Siegfried Schubert, Randy Koster, Yoo-Geun Ham and Max Suarez

Wang et al. 2013



Focus on T2m



MERRA

Ensemble mean 12 GEOS-5 AMIP simulations

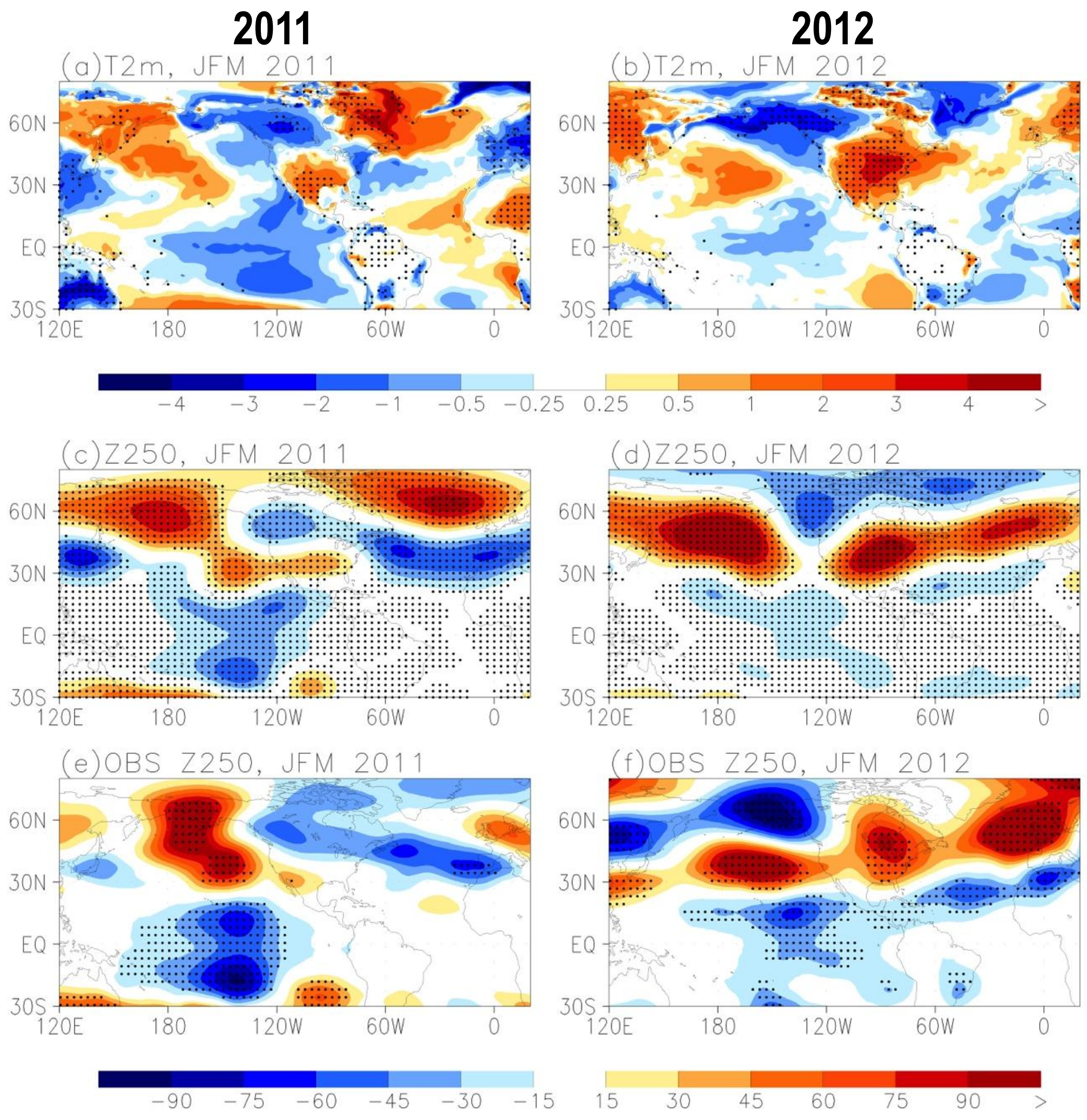
Focus on JFM

Simulated T2m

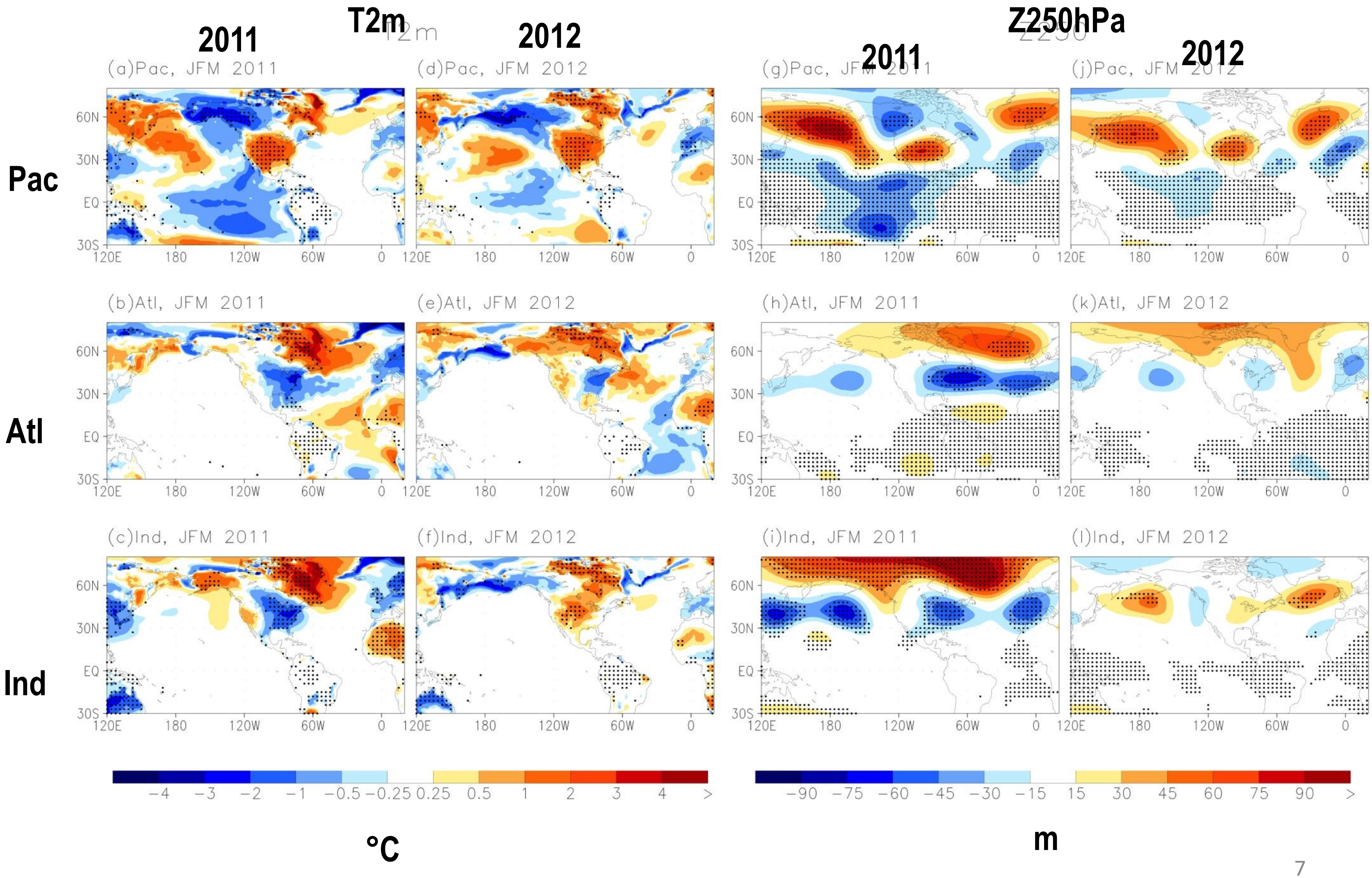
°C

Simulated 250hPa height (m)

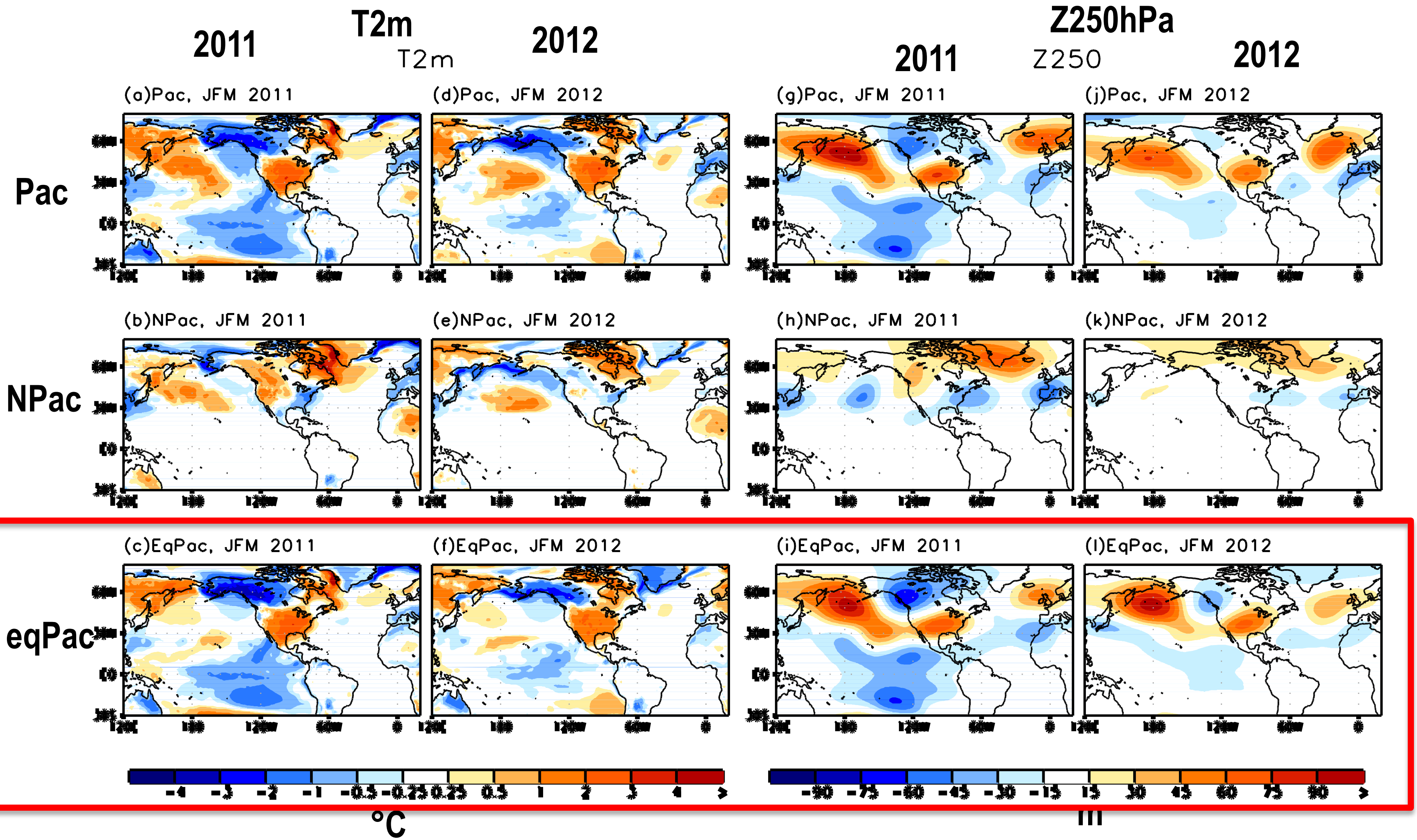
Observed (MERRA) 250hPa height (m)



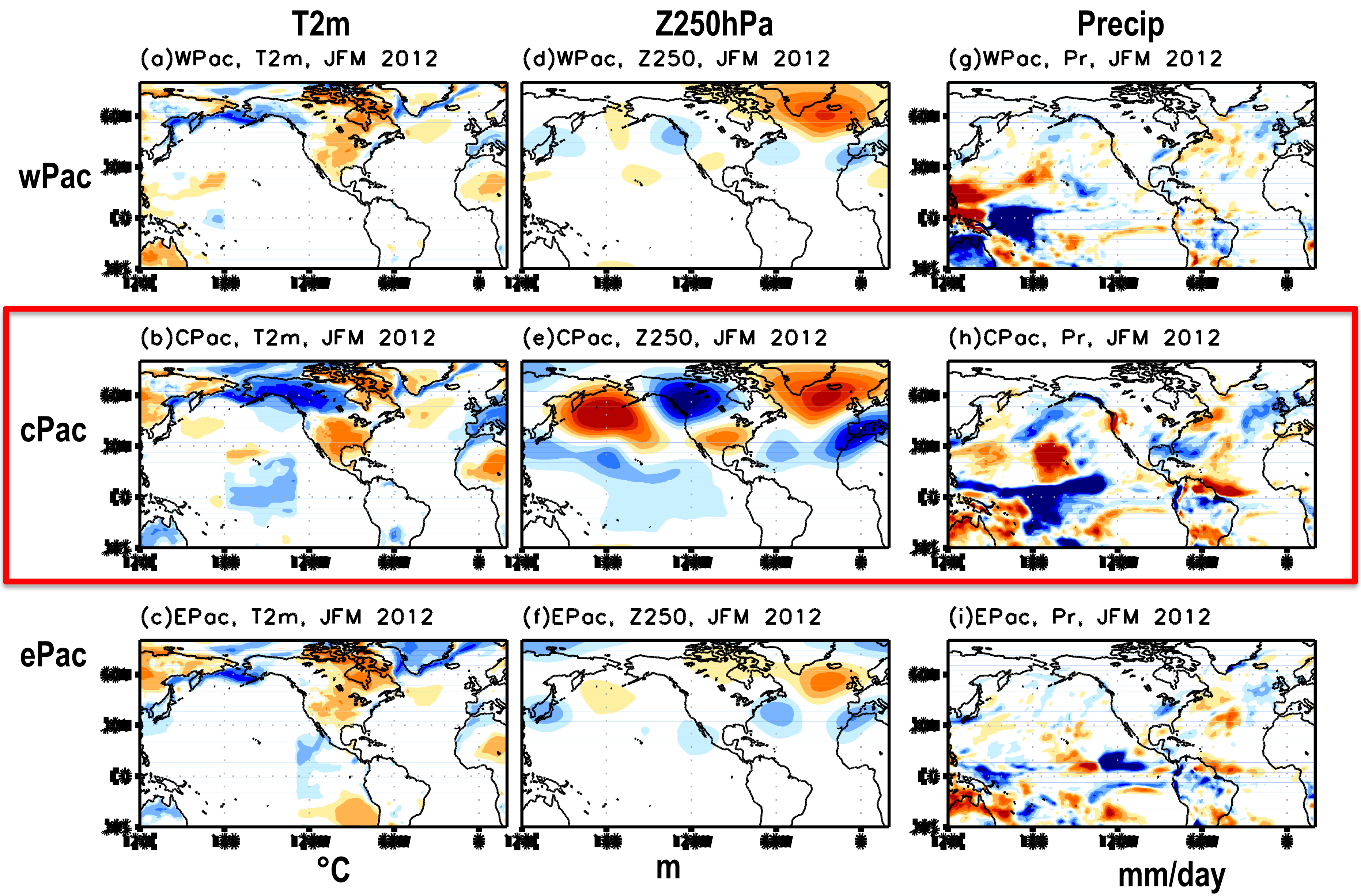
JFM Impacts of Pacific, Atlantic, and Indian Ocean SST



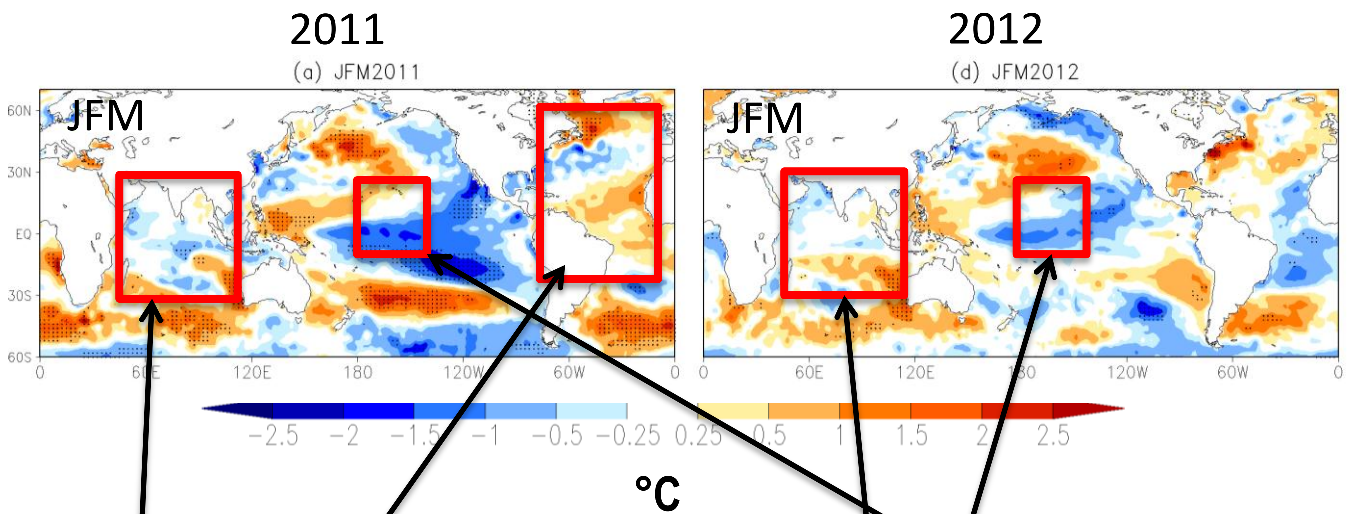
Decomposing the Impact of the Pacific SST



Decomposing the Impact of the 2012 Equatorial Pacific SST



So What Matters for 2011 and 2012 JFM T2m Responses over the US in Terms of SST?



These drive continental-wide warming over the US in both years

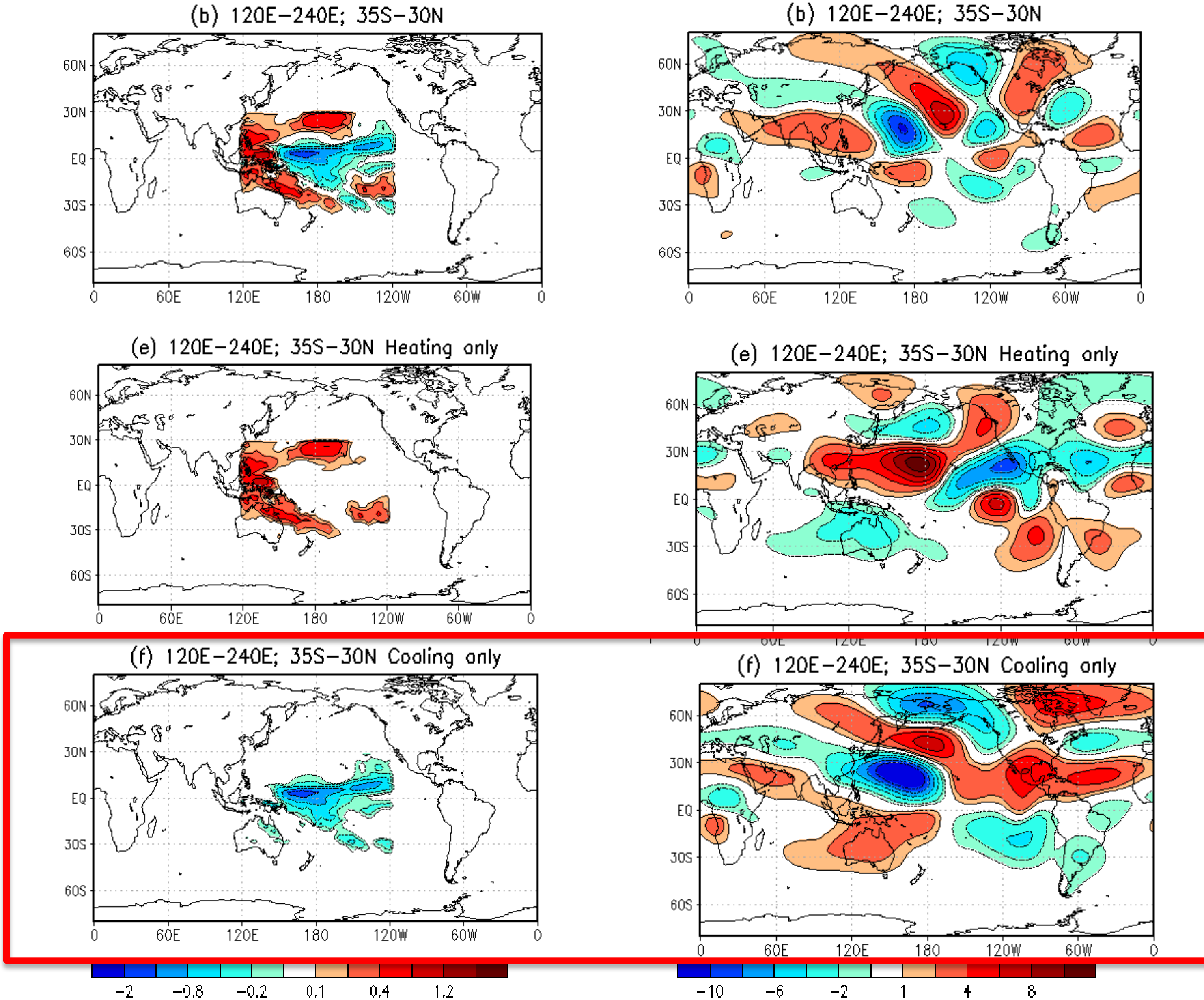
These act to reinforce the warming over the US in 2012

These act to counteract the warming over the US in 2011

Diagnosing the AGCM JFM 2012 Response to Heating in the Pacific

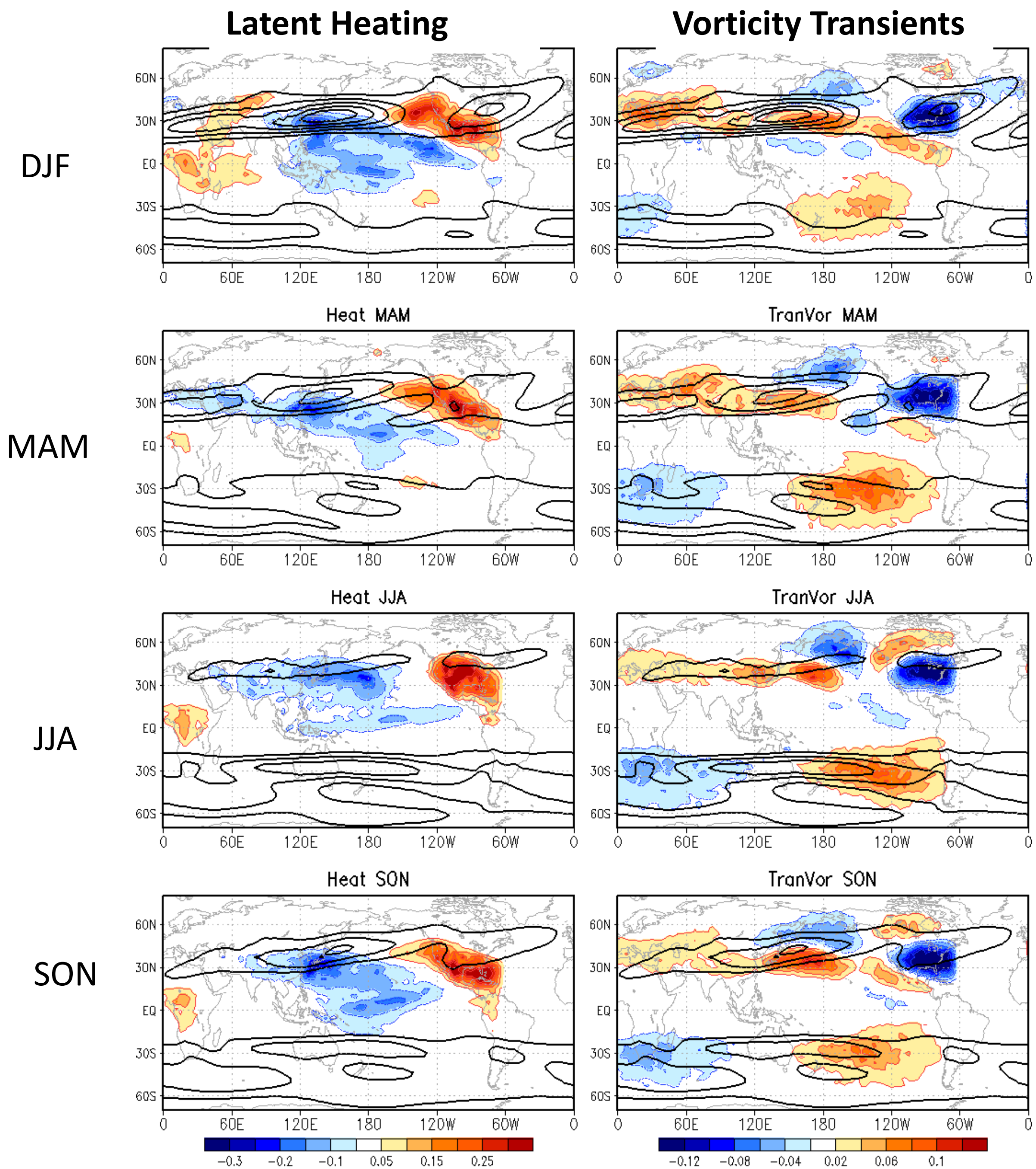
Vertically-integrated Heating

SWM response (eddy stream function)



Central Equatorial cooling is key

Forcing That Produces a Positive Upper Level Stream Function Response Over US



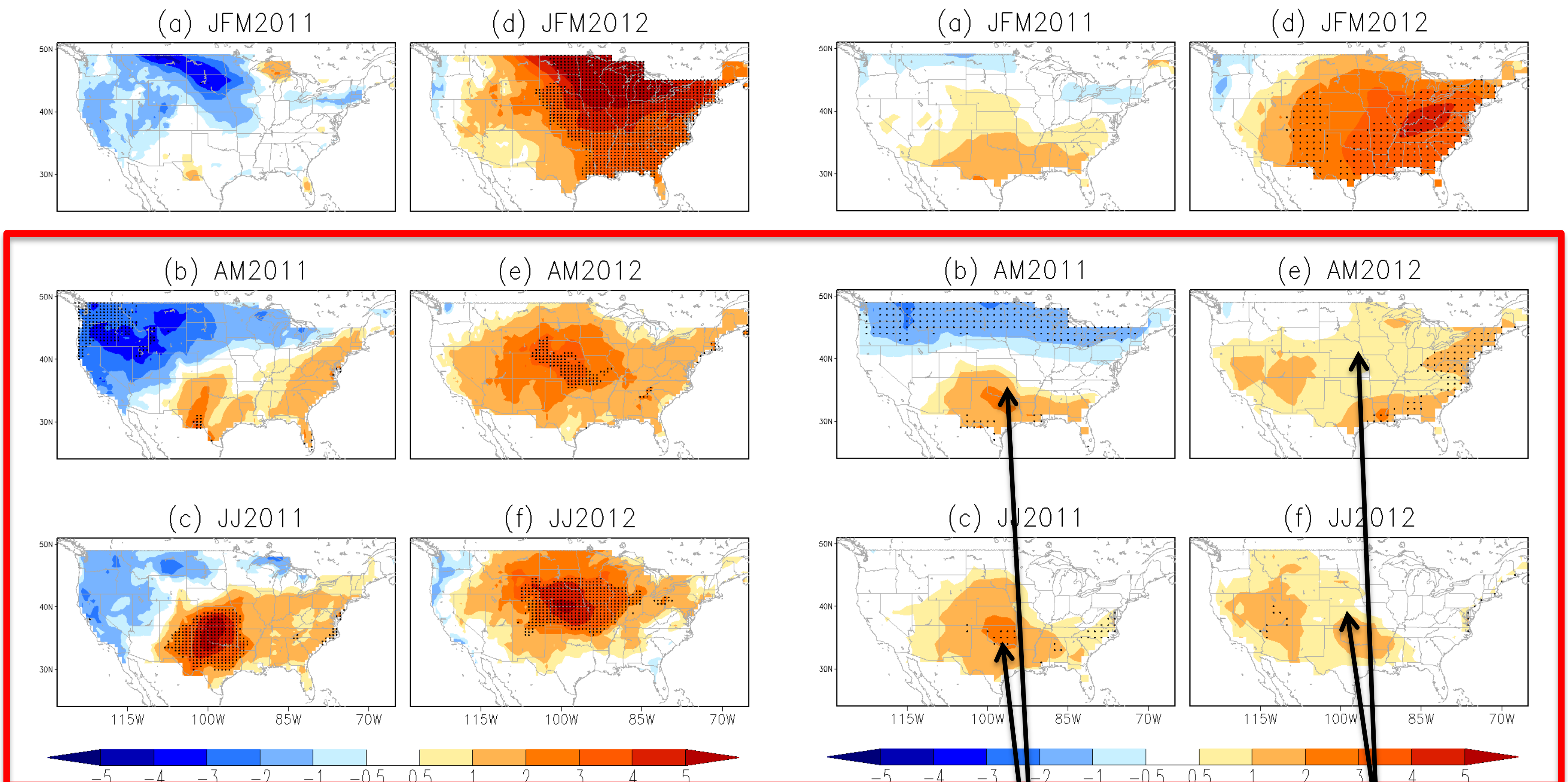
Contours are the mean upper tropospheric jets estimated from MERRA

Colored regions are the US upper tropospheric Stream Function responses to idealized localized forcing plotted at the forcing locations, and weighted by std of the actual atmospheric forcing as estimated from MERRA

Now focus on warm season

Observed T2m

Simulated T2m



Persistence? Land impacts?

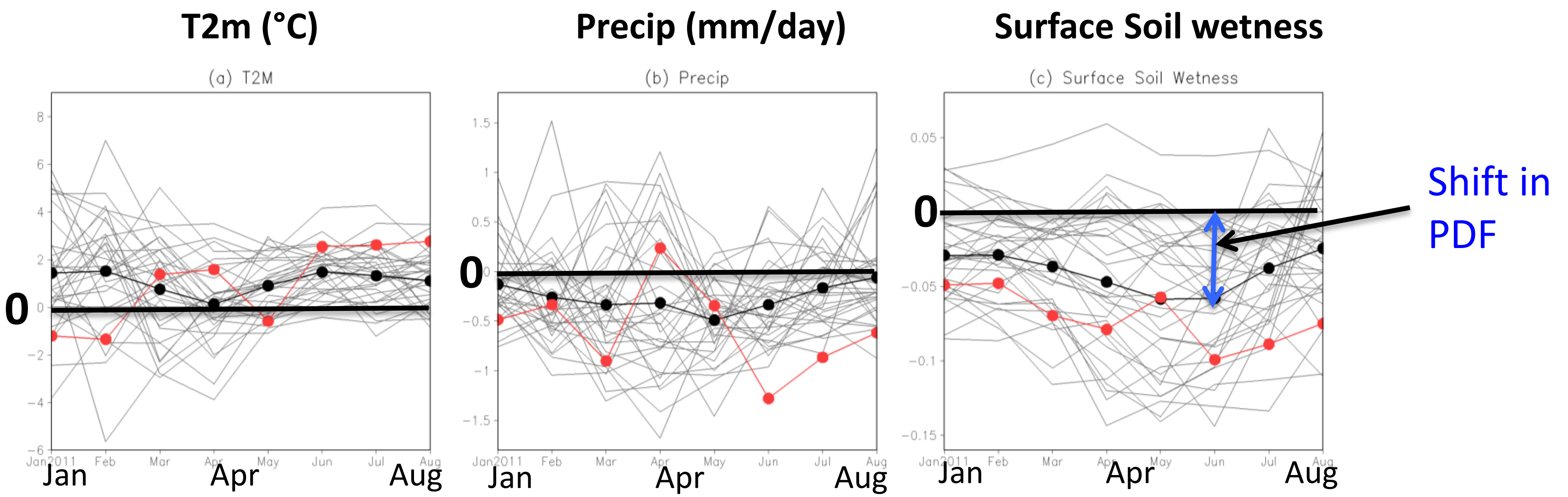
Some impact of SST in region of interest

Weak/no SST impact in region of interest

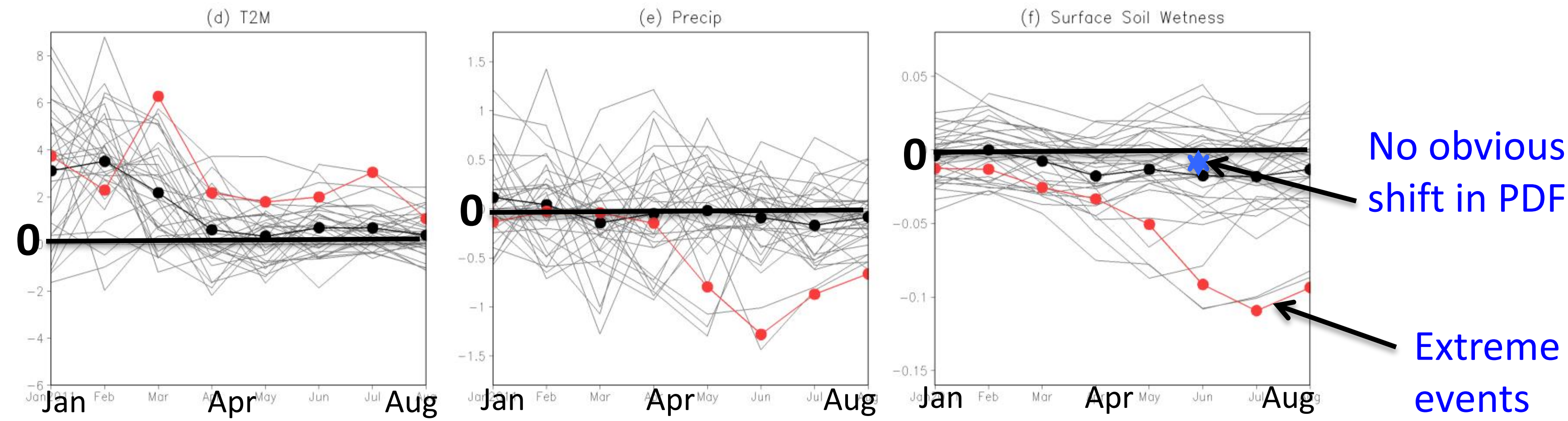
MERRA

Ensemble mean 12 GEOS-5 AMIP simulations

2011 (southern Great Plains)



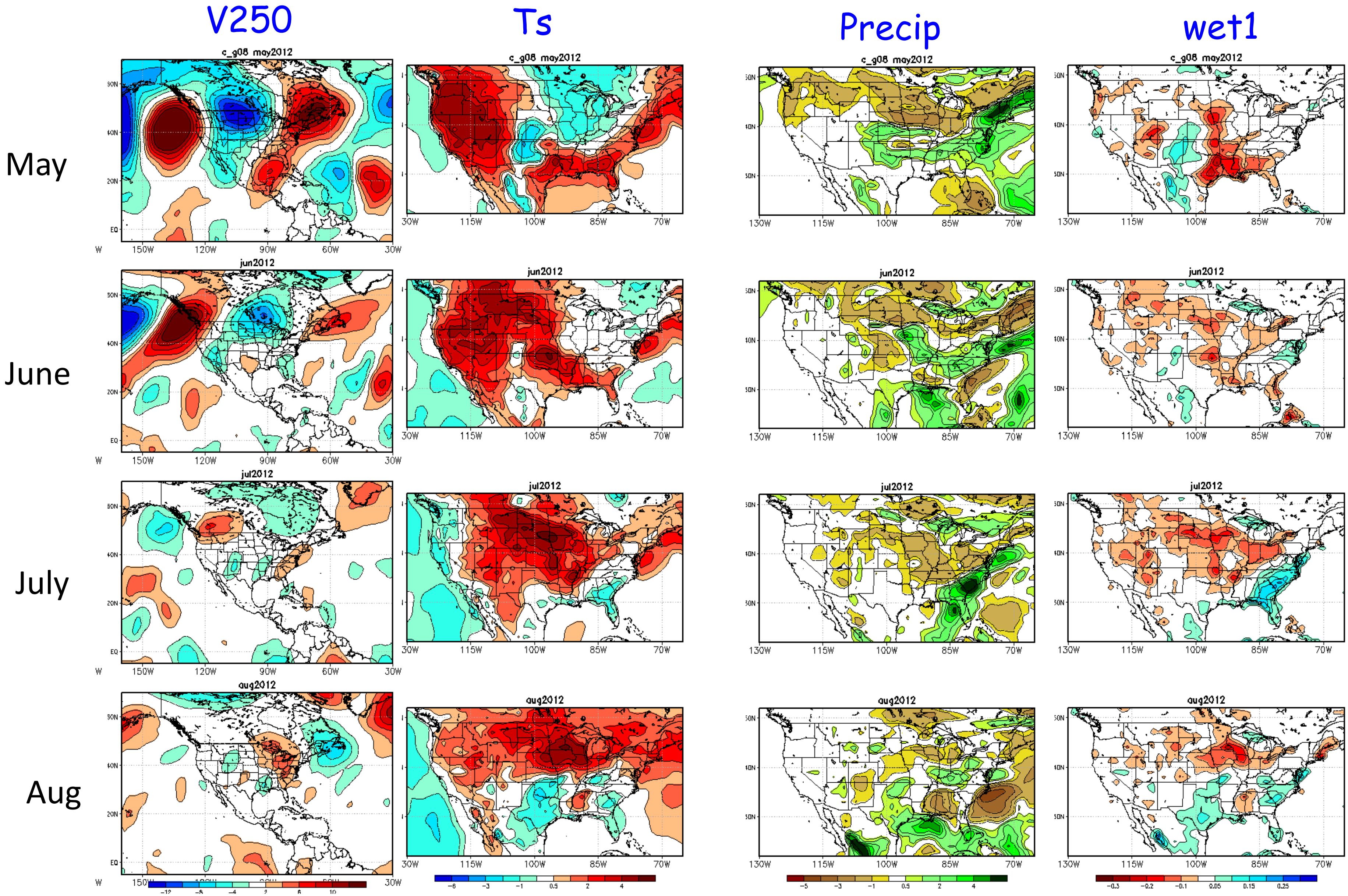
2012 (central Great Plains)



32 ensemble members , heavy black is ensemble mean, red is “observed”

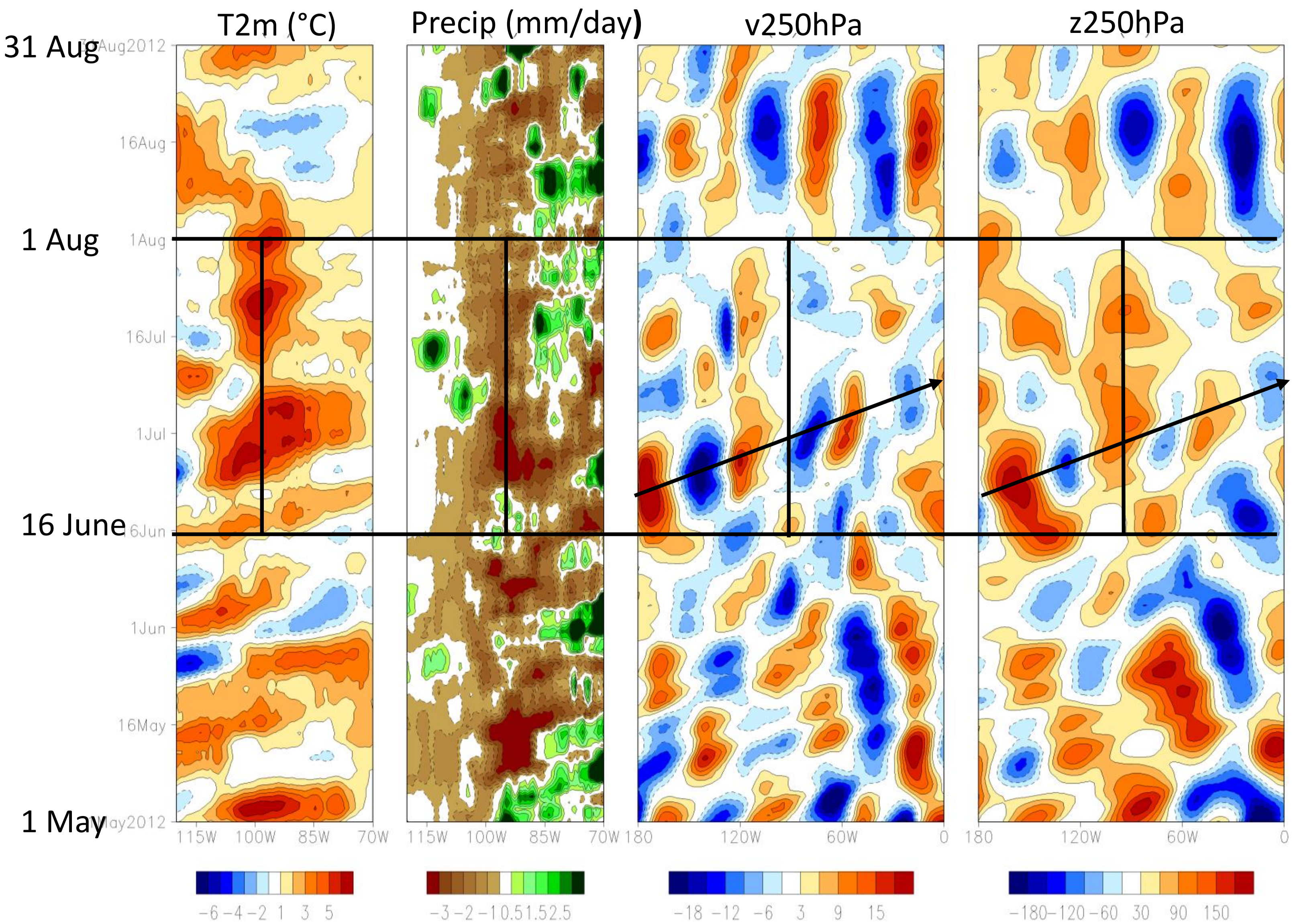
What caused the extreme events in the Model?

Ensemble Member cg08 (2012)

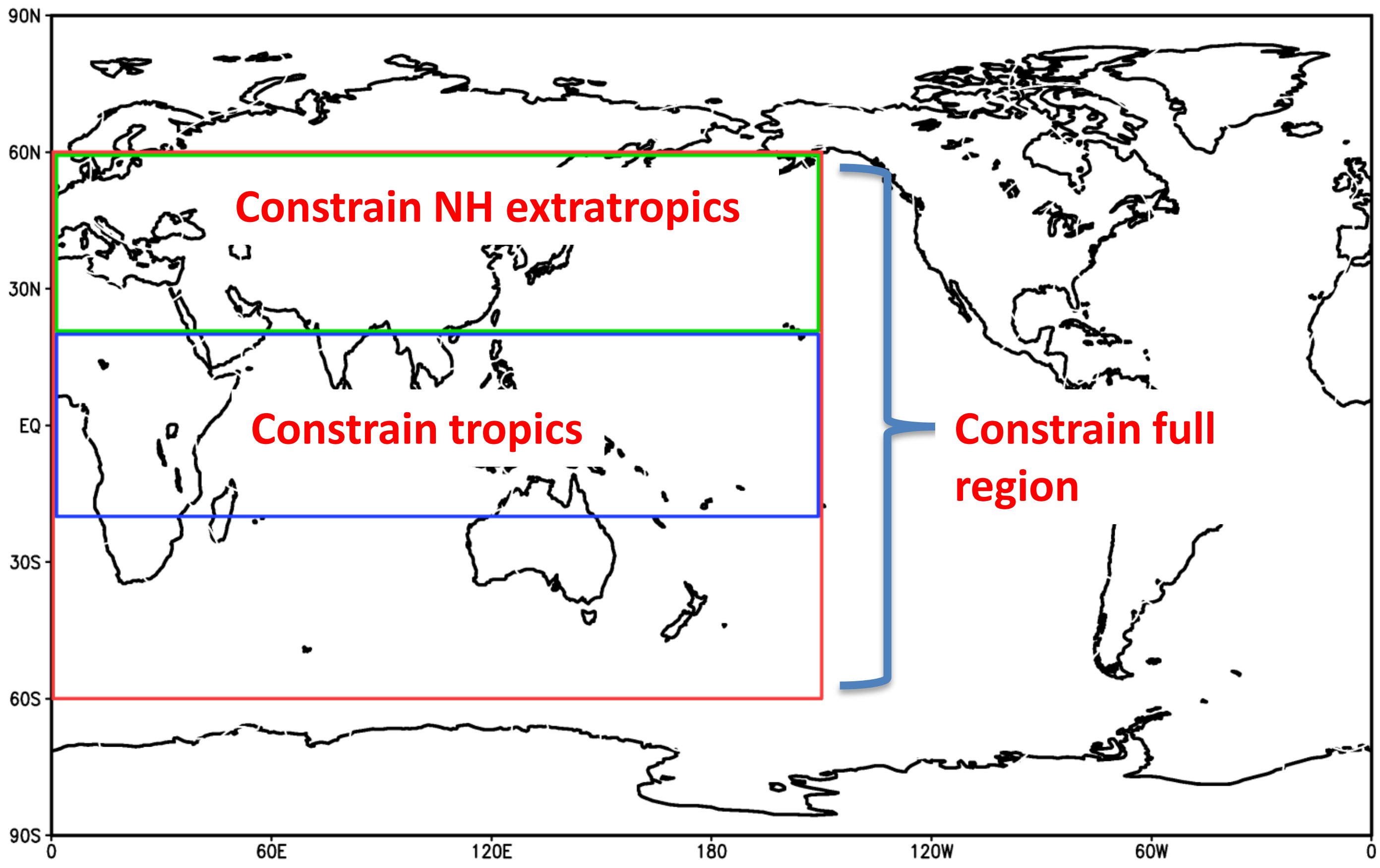


What caused the extreme event in nature?

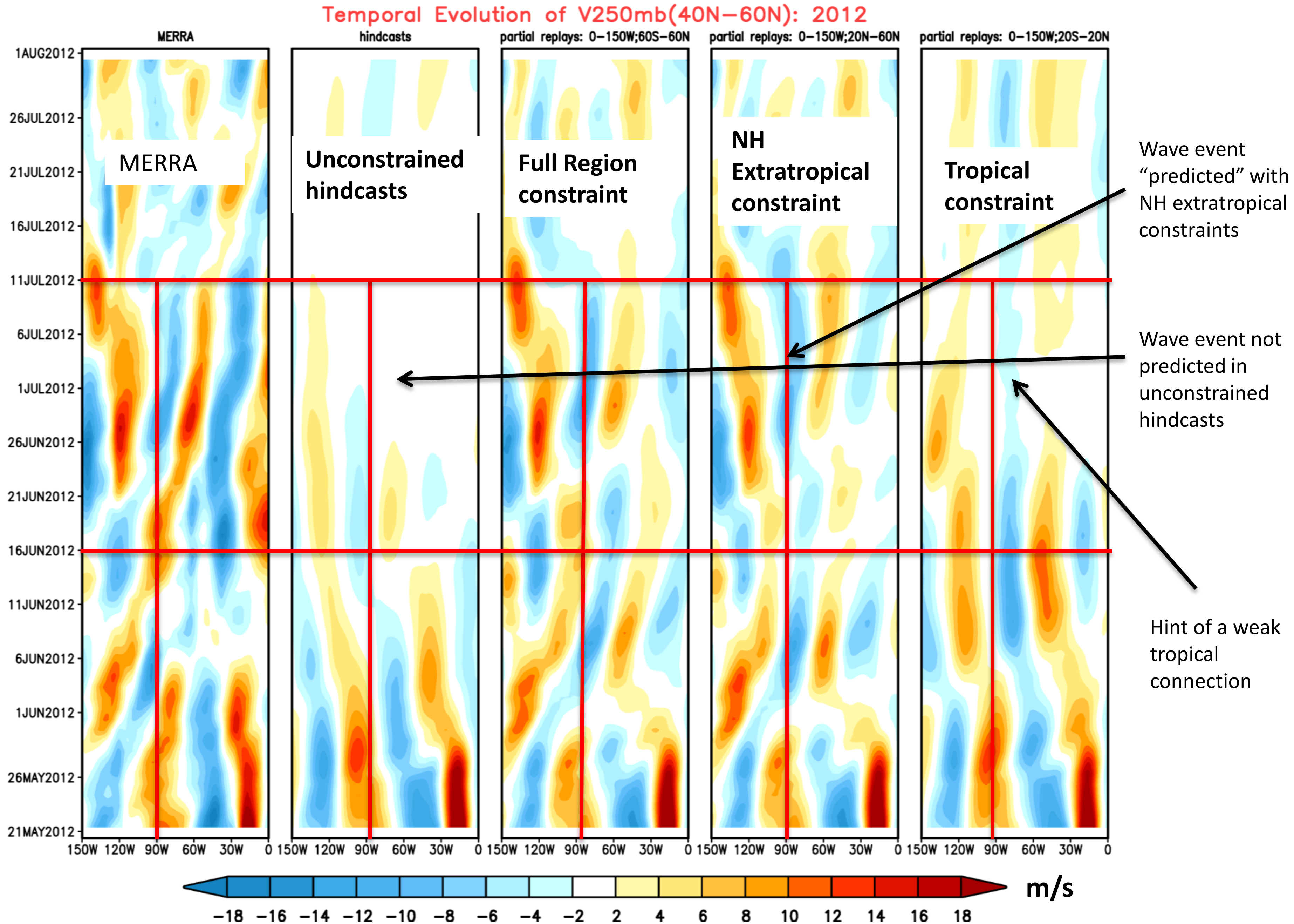
Evolution of 2012 anomalies based on MERRA



Hindcast/Replay experiments for 2012 with GEOS-5 AGCM and observed SST forcing



Constraints imposed in such a way as to keep the simulation close to MERRA at each time step in specified region



Unconstrained is mean of 32 hindcasts, all partial replays consist of 10 ensemble members

Challenges

- Improve understanding of responses to SST outside the equatorial Pacific – AMIP runs may not be the best tool!
- Improve SST predictions in Indian and Atlantic Oceans
- In general, need to better quantify what aspects of SST matter for regional responses (see e.g. Shin, Sardeshmukh and Webb 2010)
- At subseasonal time scales need to better understand the role and nature of atmospheric forcing in generating wave responses (these appear to be key to generating some short term extremes especially during boreal summer)
- Need to better understand/simulate the local responses/interactions (LLJs, land feedbacks, etc)
- Need to better understand and quantity changes in predictability (forecasts of opportunity)

Drought Task Force focus areas/themes:

- **improving narrative communication on causes of drought** (key issues include the role of soil moisture, ocean conditions, evaporative demand, land surface-precipitation-temperature relationships, cross-temporal and cumulative aspects of drought risk).

- **Quantifying current monitoring and prediction capabilities**, and particularly improvements attributable to the Drought Task Force projects.

- **Identifying and investigating areas that offer the most promise for improving operational capabilities**, and strengthening the drought research to operations capabilities (RtC)

Monthly telecons have been structured to reflect the above themes

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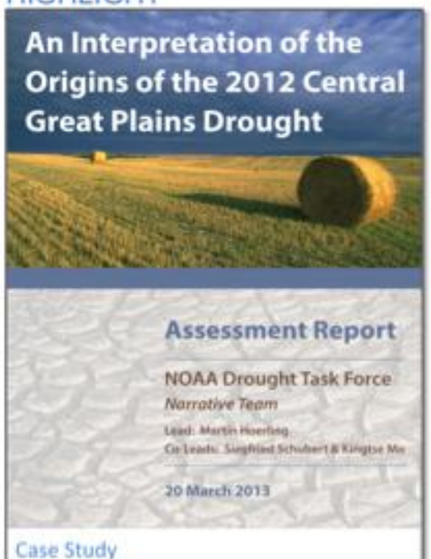
DROUGHT TASK FORCE

NIDIS

Advancing drought monitoring and prediction over North America

HIGHLIGHT



At its peak last summer, moderate to extreme drought gripped 61 percent of the Lower 48, but a "flash drought" brought exceptionally intense conditions to the Central Great Plains. A new case study by the NOAA Drought Task Force and the NOAA-led National Integrated Drought Information System (NIDIS) finds natural variations in weather patterns caused this sudden "flash drought." The report rules out global ocean conditions, as well as human-induced climate change, as major culprits.

Click here to learn more...

NOA's Drought Task Force was established in October 201 with the ambitious goal of achieving significant new adv ces in the ability to understand, monitor and predict drou ht over North America. The Task Force (duration is Oct er 2011 – September 2014) is an initiative of NOAA's Clim te Program Office Modeling, Analysis, Predictions, and rojections (MAPP) program in partnership with NIDIS. It br gs together over thirty leading MAPP-funded drought scie ists from multiple academic and federal institutions (inv ves scientists from NOAA's research laboratories and cent rs, NASA, U.S. Department of Agriculture, NCAR and mar universities), in a concerted research effort that builds on i dividual MAPP research projects. These projects span the ide spectrum of drought research needed to make fund mental advances, from those aimed at the basic und standing of drought mechanisms to those aimed at testi g new drought monitoring and prediction tools for ope tional and service purposes (as part of NCEP's Clim te Test Bed). The Drought Task Force provides focus and oordination to MAPP drought research activities, and also acilitates synergies with other national and inte ational drought research efforts, including those by the GDI

Clic here for more information.

Advancing NIDIS Objectives

How Research Is Improving How We Monitor and Predict Drought

Research Objectives

Understanding, Monitoring, and Predicting Drought

Implementation:

Organization

Projects

MAPP

Modeling, Analysis, Predictions, and Projections

The Modeling, Analysis, Predictions, and Projections (MAPP) Program's mission is to enhance the Nation's capability to understand and predict natural variability and changes in Earth's climate system. The MAPP Program supports development of advanced climate modeling technologies to improve simulation of climate variability, prediction of future climate variations from weeks to decades, and projection of long-term future climate conditions. To achieve its mission, the MAPP Program supports research focused on the coupling, integration, and application of Earth system models and analyses across NOAA, among partner agencies, and with the external research community.

Learn more...

- Home
- MAPP Task Forces
  - *Drought Task Force*
  - *CMIP5 Task Force*
  - *Climate Prediction Task Force*
  - *Climate Reanalysis Task Force*
- Webinar Series
- Funding Opportunities & Projects
- Publications
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Upcoming Events

10/22/2013 - 10/23/2013

Upcoming Climate Prediction Task Force meeting

The Climate Prediction Task Force Meeting is taking place Oct. 22-23 in College Park jointly with the NOAA's 38th CDPW.

A DTF Special Collection of the Journal of Hydrometeorology

Topic: "Advancing Drought Monitoring and Prediction"

Organizers: Siegfried Schubert, Annarita Mariotti, Kingtse Mo

Collection to include 16 papers spanning prediction, understanding and monitoring

Prediction research gaps:

- current prediction skill versus predictability
- are there under exploited sources of predictability?
- how can improved understanding in hydrological processes (land, ocean atmosphere) lead to improvements in predictive skill?

Monitoring research gaps:

-do we have the data, methodologies and metrics to document improvements?

-what are the most promising new methodologies and data?

-how can local, regional and national systems be best coordinated?

-what are the challenges in scaling up monitoring to global scales?

Improvements in drought information systems:

-what are the missing elements (monitoring and prediction)

-which are "science-limited" that require additional research?

-are there societal sectors currently not being adequately served?

a) Monitoring :

A1: The relationship between 2-meter air temperature and lapse rate in the western U.S., Jiarui Dong, Brian Cosgrove, Michael Ek, Kingtse Mo

A2: Using Temperature to Quantitatively Predict the MODIS Fractional Snow Cover Retrieval Errors over CONUS. Jiarui Dong, Mike Ek, Dorothy Hall, Christa Peters-Lidard, Brian Cosgrove, Jeff Miller, George Riggs, Youlong Xia

A3: A Nonparametric Multivariate Multi-Index Drought Monitoring Framework, Zengchao Hao and Amir Aghakouchak

A4: An Intercomparison of Drought Indicators Based on Thermal Remote Sensing and NLDAS-2 Simulations with U.S. Drought Monitor Classifications, Martha Anderson et al.

A5: Uncertainties, relationships and optimal blends of ensemble-mean NLDAS drought indices, Xia, Youlong., M.B. Ek, D. Mocko, C. Peters-Lidard, J. Sheffield, J. Dong, and E.F. Wood, 2012:

A6: Examining Rapid onset drought development using the thermal infrared based evaporative stress index, Otkin et al

A7: Comparing Evaporative Sources of Terrestrial Precipitation and Their Extremes in MERRA Using Relative Entropy, Dirmeyer

A8: Objective drought classification using multiple land surface models, Kingtse Mo and Dennis Lettenmaier

A9: A prototype global drought information system based on multiple land surface models, Bart Nijssen et al

b) Prediction :

B1: Dynamical Causes of the 2010/11 Texas Northern Mexico Drought, Richard Seager, Lisa Goddard, Jennifer Nakamura, Naomi Henerson, Donna Lee

B2: On the role of SST forcing in 2011 and 2012 Extreme U.S. Heat and Drought: A Study in Contrasts, Hailan Wang, Siegfried Schubert, Randy Koster, Yoo-Geun Ham and Max Suarez

B3: Soil Moisture Initialization Error and Subgrid Variability of Precipitation in Seasonal Streamflow Forecasting, Randy Koster, Gregory K. Walker, Sarith P. P. Mahanama, and Rolf H. Reichle

B4: Southeast US Rainfall Prediction in the National Multi-Model Ensemble, Johnna M. Infanti and Ben P. Kirtman

B5: Probabilistic Seasonal Forecasting of African Drought by Dynamical Models, Xing Yuan et al. – submitted

B6: A Bayesian Framework for Probabilistic Seasonal Drought Forecasting, Shahrbanou Madadgar and Hamid Moradkhani

B7: Causes and Predictability of the 2012 Great Plains Drought: M. Hoerling, J. Eischeid, A. Kumar, R. Leung, A. Mariotti, K. Mo, S. Schubert, and R. Seager (BAMS)